

HCC4051B/52B/53B
HCF4051B/52B/53B

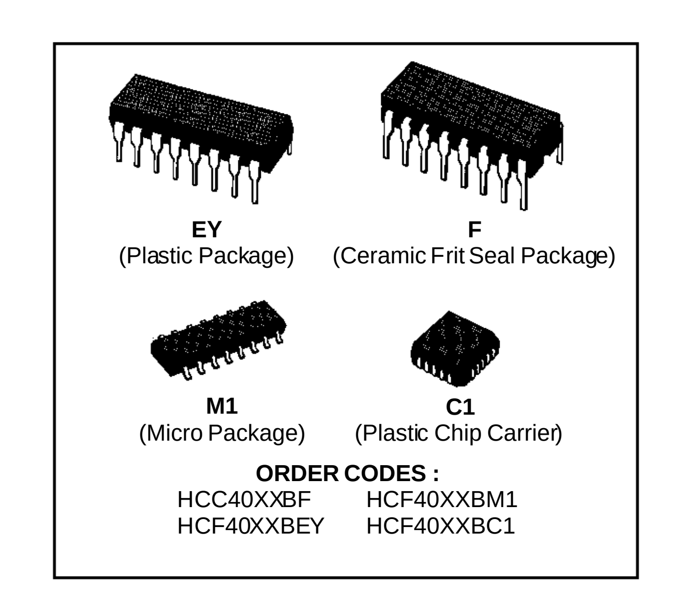
ANALOG MULTIPLEXERS-DEMULTIPLEXERS

4051B - SINGLE 8-CHANNEL

4052B - DIFFERENTIAL 4-CHANNEL

4053B - TRIPLE 2-CHANNEL

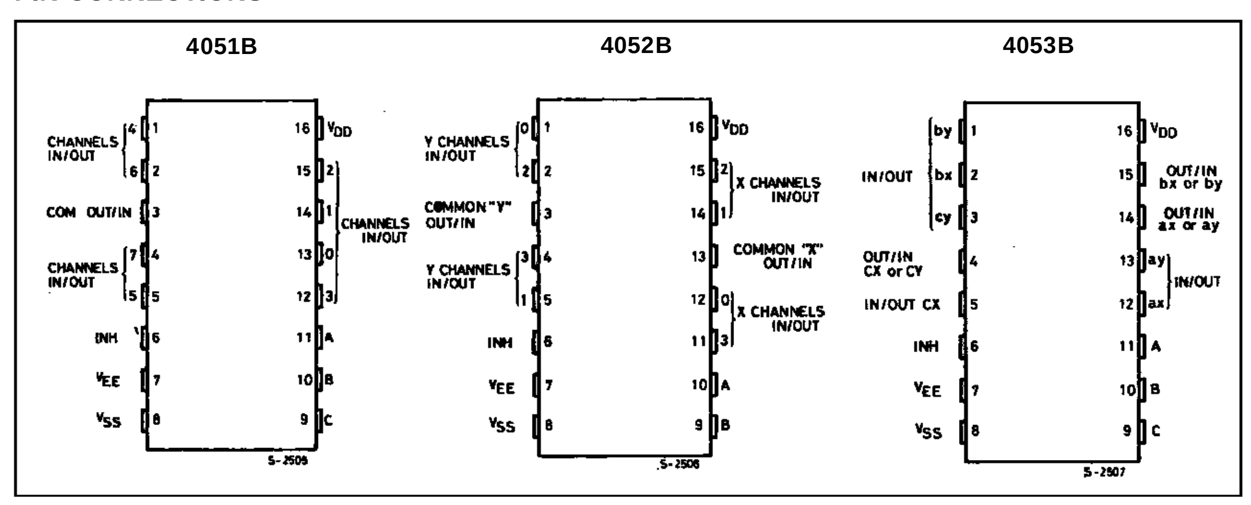
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- LOW "ON" RESISTANCE : 125Ω (typ.) OVER 15V p.p. SIGNAL-INPUT RANGE FOR V_{DD}-V_{EE} = 15V
- HIGH "OFF" RESISTANCE : CHANNEL LEAKAGE ± 100pA (typ.) $V_{DD} – V_{EE}$ = 18V
- BINARY ADDRESS DECODING ON CHIP
- VERY LOW QUIESCENT POWER DISSIPATION UNDER ALL DIGITAL CONTROL INPUT AND SUPPLY CONDITIONS : 0.2 µW (typ.), $V_{DD} – V_{SS} = V_{DD} – V_{EE}$ = 10V
- MATCHED SWITCH CHARACTERISTICS : R_{ON} = 5Ω (typ.) for $V_{DD} – V_{EE}$ = 15V
- WIDE RANGE OF DIGITAL AND ANALOG SIGNAL LEVELS : DIGITAL 3 TO 20V, ANALOG TO 20V p.p.
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100mA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



DESCRIPTION

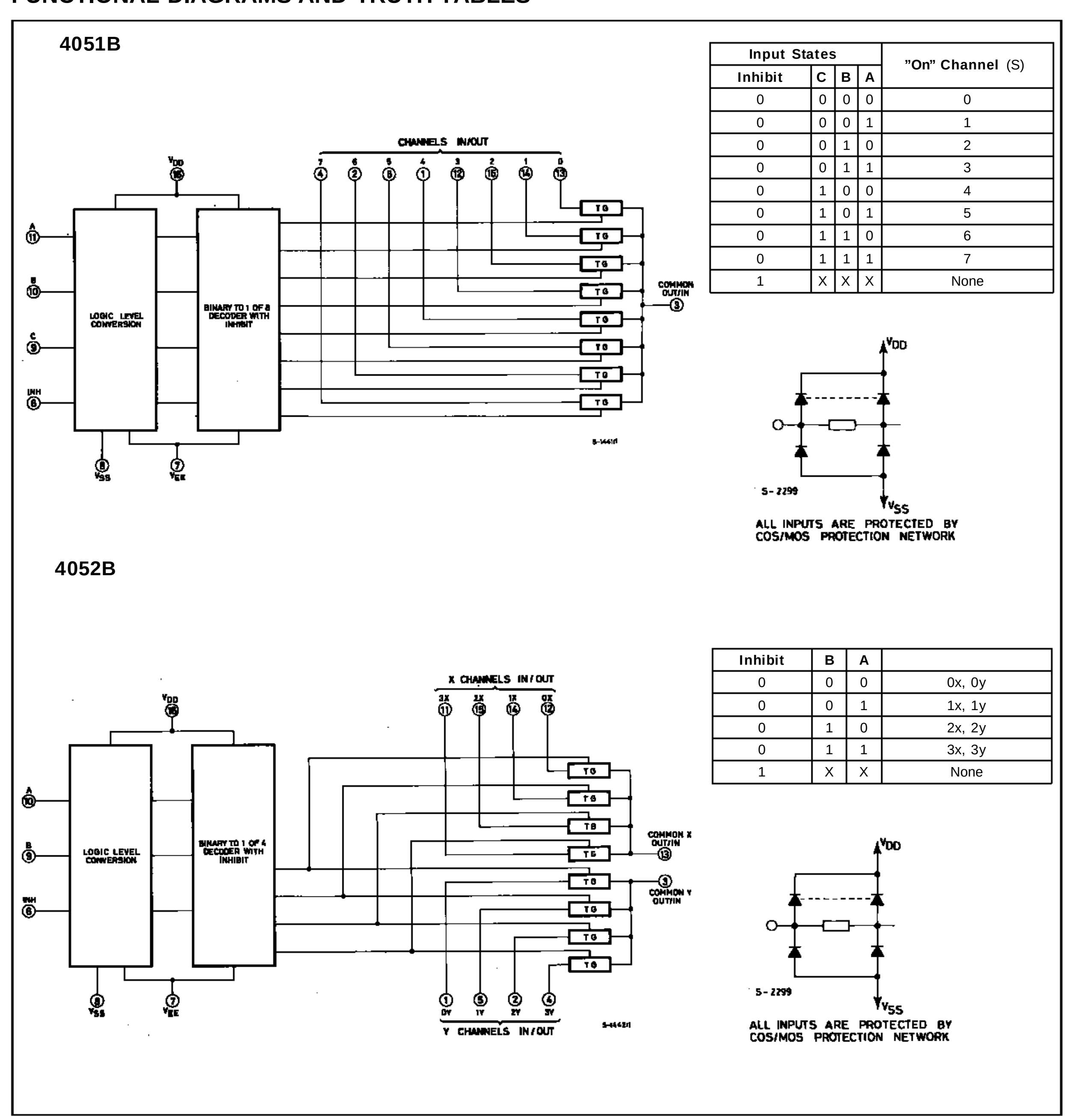
The **HCC 4051B, 4052B** and **4053B** (extended temperature range) and **HCF4051B, 4052B** and **4053B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micropackage. **HCC/HCF4051B, HCC/HCF4052B**, and **HCC/HCF4053B** analog multiplexers/demultiplexers are digitally controlled analog switches having low ON impedance and very low OFF leakage

PIN CONNECTIONS



current. These multiplexer circuits dissipate extremely low quiescent power over the full $V_{DD} - V_{SS}$ and $V_{DD} - V_{EE}$ supply-voltage ranges, independent of the logic state of the control signals. When a-logic "1" is present at the inhibit input terminal all channel are off. The **HCC/HCF4051B** is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output. The **HCC/HCF4052B** is a differential 4-channel multiplexer having two binary control inputs, A and B, and an inhibit input. The two binary input signals select 1 of 4 pairs of channels to be turned on and connect the analog inputs to the outputs. The **HCC/HCF4053B** is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a singlepole double-throw configuration.

FUNCTIONAL DIAGRAMS AND TRUTH TABLES



Input States				"On" Channel (S)
Inhibit	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	None

Inhibit	B	A	
0	0	0	0x, 0y
0	0	1	1x, 1y
0	1	0	2x, 2y
0	1	1	3x, 3y
1	X	X	None

FUNCTIONAL DIAGRAMS AND TRUTH TABLES (continued)

4053

Inhibit	A or B or C	
0	0	ax or bx or cx
0	1	ay or by or cy
1	X	None

X = Don't care.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DD}*	Supply Voltage : **HCC** Types **HCF** Types	– 0.5 to + 20 – 0.5 to + 18	V V
V_i	Input Voltage	– 0.5 to V_{DD} + 0.5	V
I_I	DC Input Current (any one input)	± 10	mA
P_{tot}	Total Power Dissipation (per package) Dissipation per Output Transistor for T_{op} = Full Package-temperature Range	200 100	mW mW
T_{op}	Operating Temperature : **HCC** Types **HCF** Types	– 55 to + 125 – 40 to + 85	°C °C
T_{stg}	Storage Temperature	– 65 to + 150	°C

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

* All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage : **HCC** Types **HCF** Types	3 to 18 3 to 15	V V
V_I	Input Voltage	0 to V_{DD}	V
T_{op}	Operating Temperature : **HCC** Types **HCF** Types	– 55 to + 125 – 40 to + 85	°C °C

STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value							Unit
			V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	T_{Low}*		25 °C			T_{High}*		
							Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
I_L	Quiescent Device Current	HCC Types				5		5		0.04	5		150	µA
						10		10		0.04	10		300	
						15		20		0.04	20		600	
						20		100		0.08	100		3000	
		HCF Types				5		20		0.04	20		150	
						10		40		0.04	40		300	
						15		80		0.04	80		600	
SWITCH														
ON	Resistance	HCC Types	$0 \le V_I \le V_{DD}$	0	0	5		880		470	1050		1200	Ω
						10		310		180	400		580	
						15		220		125	280		400	
		HCF Types	$0 \le V_I \le V_{DD}$	0	0	5		880		470	1050		1200	
						10		330		180	400		520	
						15		230		125	280		360	
ΔON	Resistance ΔR_{ON} (between any 2 channels)			0	0	5				10				Ω
						10				10				
						15				5				
OFF (•) Channel Leakage Current	Any Channel OFF	HCC Types		0	0	18		100		± 0.1	100		1000	nA
	All Channels OFF (common OUT/IN)	HCC Types		0	0	18		100		± 0.1	100		1000	nA
	Any Channel OFF	HCF Types		0	0	15		300		± 0.1	300		1000	nA
	All Channels OFF (common OUT/IN)	HCF Types		0	0	15		300		± 0.1	300		1000	nA
C Capacitance	Input									5				pF
	Output 4051			– 5	– 5	5				30				
	Output 4052									18				
	Output 4053									9				
	Feedthrough									0.2				
CONTROL (Address or Inhibit)														
V_{IL}	Input Low Voltage		$= V_{DD}$ Thru 1KΩ	$V_{EE} = V_{SS}$ $R_L = 1K\Omega$ to V_{SS} $I_{IS} < 2\mu A$ (on all off channels)		5		1.5			1.5		1.5	V
						10		3			3		3	
						15		4			4		4	
V_{IH}	Input High Voltage					5	3.5		3.5			3.5		V
						10	7		7			7		
						15	11		11			11		
I_{IH}, I_{IL}	Input Leakage Current	HCC Types	V_I = 0/18V			18		± 0.1		$\pm 10^{-3}$	± 0.1		± 1	µA
		HCF Types	V_I = 0/15V			15		± 0.3		$\pm 10^{-3}$	± 0.3		± 1	
C_I	Input Capacitance		Any Address or Inhibit Input							5	7.5			pF

(•) Determined by minimum feasible leakage measurement for automatic testing.
(*) T_{Low} = – 55°C for **HCC** device : – 40°C for **HCF** device.
(*) T_{High} = + 125°C for **HCC** device : + 85°C for **HCF** device.

DYNAMIC ELECTRICAL CHARACTERISTICS

(T_{amb} = 25°C, C_L = 50pF all input square wave rise and fall time = 20ns)

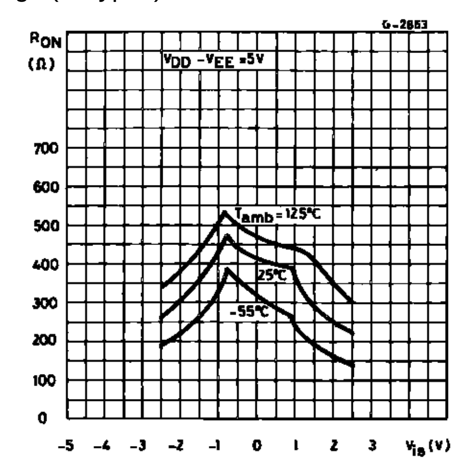
Parameter	Test Conditions								Value		Unit
	V_{EE} (V)	R_L (kΩ)	f_i (kHz)	V_{IS} (V)	V_{SS} (V)	V_{DD} (V)			Typ.	Max.	
SWITCH											
t_{pd} Propagation Delay Time (signal input to output)		200		10 V		5			30	30	ns
						10			15	60	
						15			11	20	
Frequency Response Channel "ON" (sine wave input) at 20 Log $\frac{V_o}{V_I}$ = – 3dB	= V_{SS}	1		5 (•)		10	V_o at Common OUT/IN	4053B	30		MHz
								4052B	25		
								4051B	20		
							V_o at any Channel		60		
Feedthrough (all channels OFF) at 20 Log $\frac{V_o}{V_I}$ = – 40dB	= V_{SS}	1		5 (•)		10	V_o at Common OUT/IN	4053	8		MHz
								4052	10		
								4051	12		
							V_o at any Channel		8		
Frequency Signal Crosstalk at 20 Log $\frac{V_o}{V_I}$ = – 40dB	= V_{SS}	1		5 (•)		10	Between any 2 Channels		3		MHz
							Between Sections 4052B only	measured on common	6		
								measured on any channel	10		
							Between any 2 Sections 4053B only	in Pin 2 out Pin 14	2.5		MHz
								in Pin 15 out Pin 14	6		
Sine Wave Distortion f_{is} = 1kHz Sine Wave	= V_{SS}	10	1	2 (•)		5			0.3		%
		10	1	3 (•)		10			0.2		
		10	1	5 (•)		15			0.12		
CONTROL (Address or Inhibit)											
Progation Delay Time : Address-to Signal OUT Channels ON or OFF	0				0	5			360	720	ns
	0				0	10			160	320	
	0				0	15			120	240	
	– 5				0	5			225	450	
Propagation Delay Time : Inhibit to Signal OUT (channel turning ON)	0	10			0	5			360	720	ns
	0				0	10			160	320	
	0				0	15			120	240	
	– 10				0	5			200	400	
Propagation Delay Time : Inhibit to Signal OUT (channel turning OFF)	0	0.3				5			200	450	ns
	0					10			90	210	
	0					15			70	160	
	– 10					5			130	300	
Address or Inhibit to Signal Crosstalk	0	10*			0	10	$V_C = V_{DD} – V_{SS}$ (square wave)		65		mV peak

(•) Peak to peak voltage symmetrical about $\frac{V_{DD}-V_{EE}}{2}$

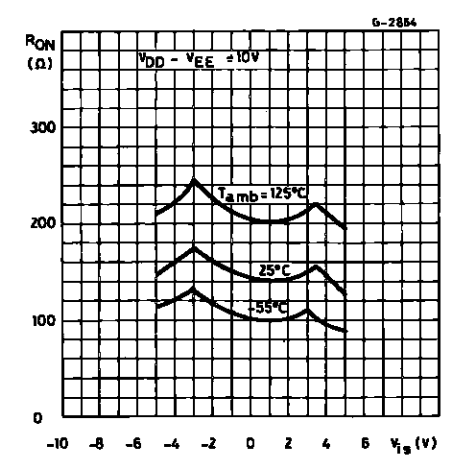
(*) Both ends of channel.



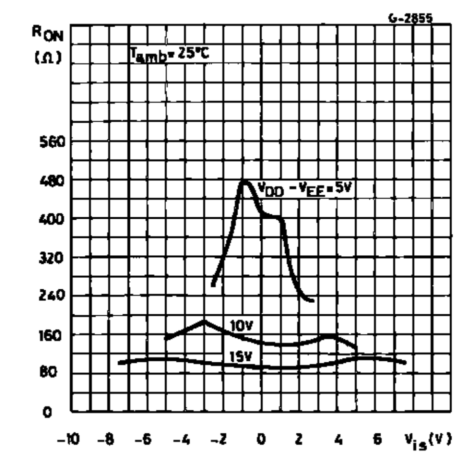
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



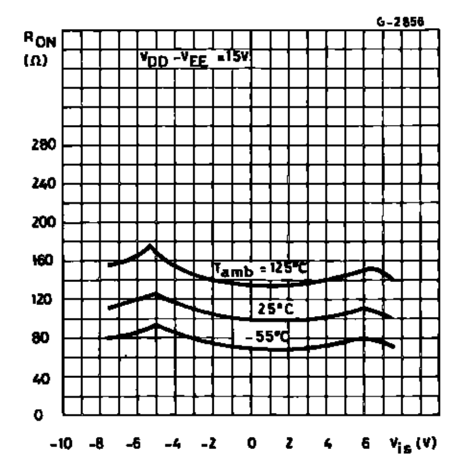
Typical Channel ON Resistance vs. Input Signal Voltage (all types).



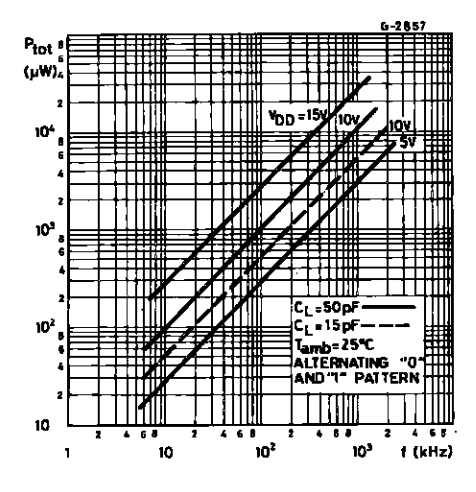
Typical Channel ON Resistance vs. Input Signal Voltage (all types).

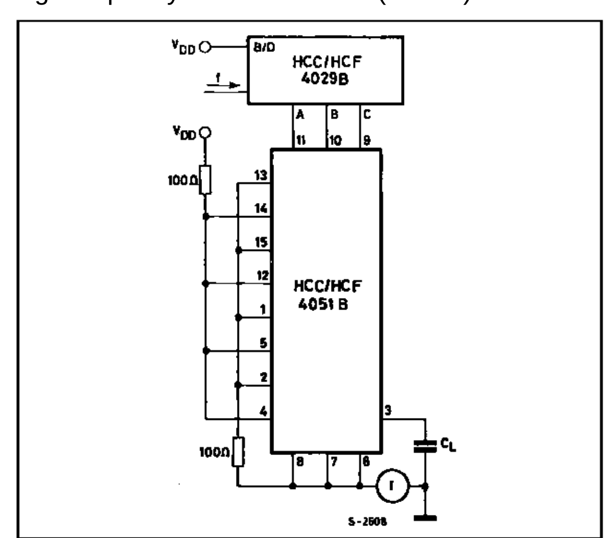


Typical Channel ON Resistance vs. Input Signal Voltage (all types).

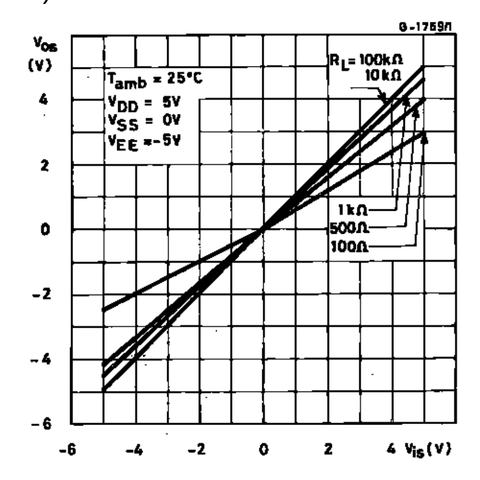


Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4051B).

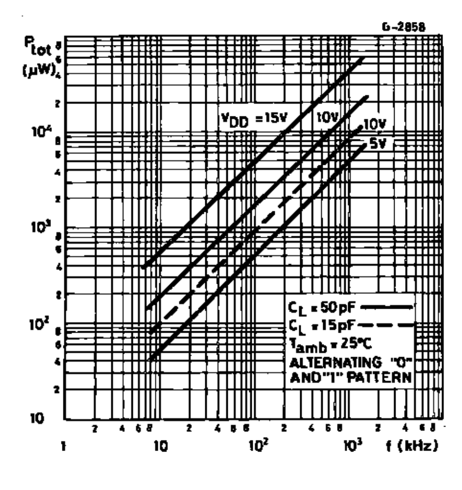


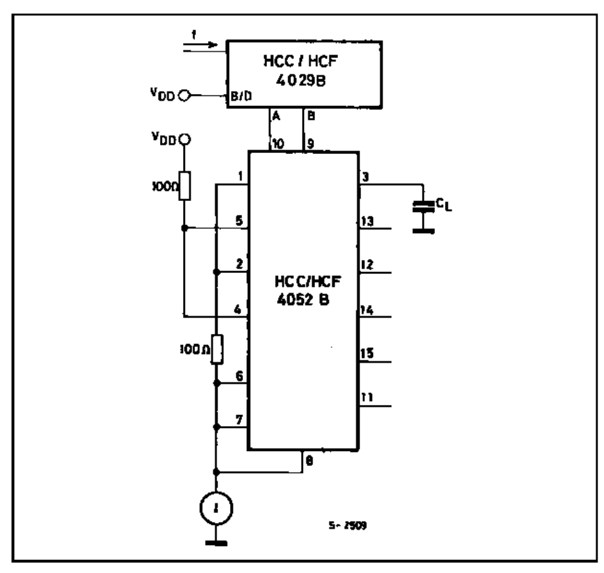


Typical ON Characteristics for 1 of 8 Channels (4051B).

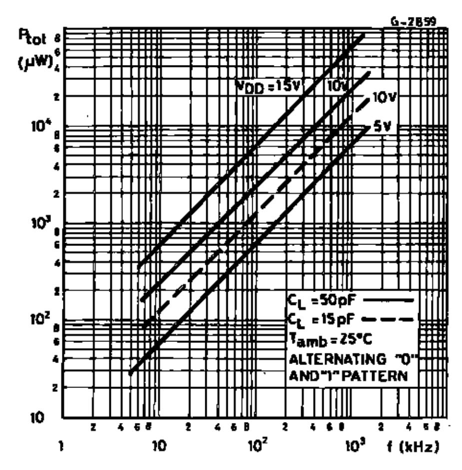


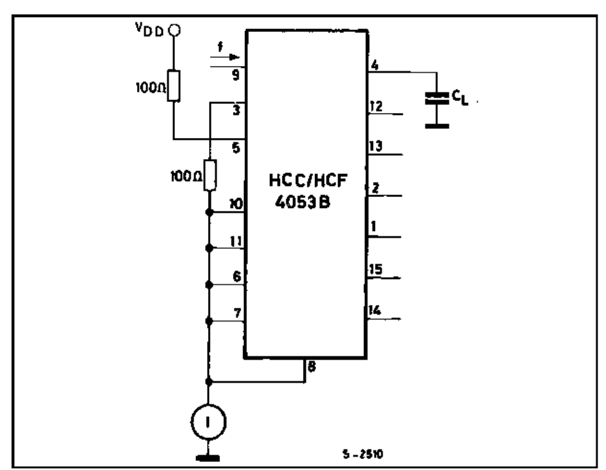
Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4052B).





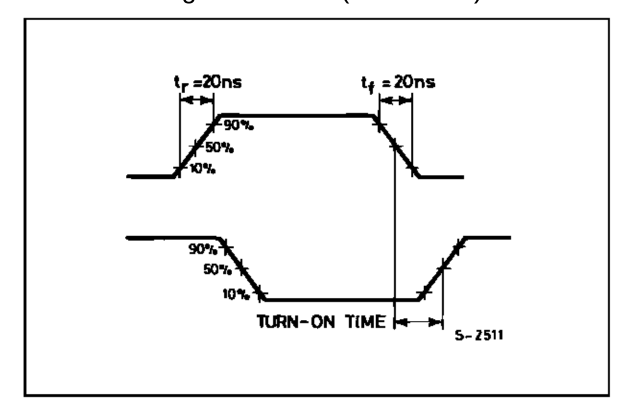
Typical Dynamic Power Dissipation/Package vs. Switching Frequency and Test Circuit (4053B).



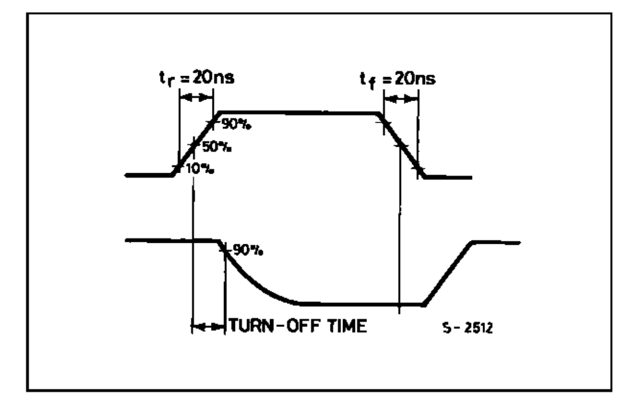


WAVEFORMS

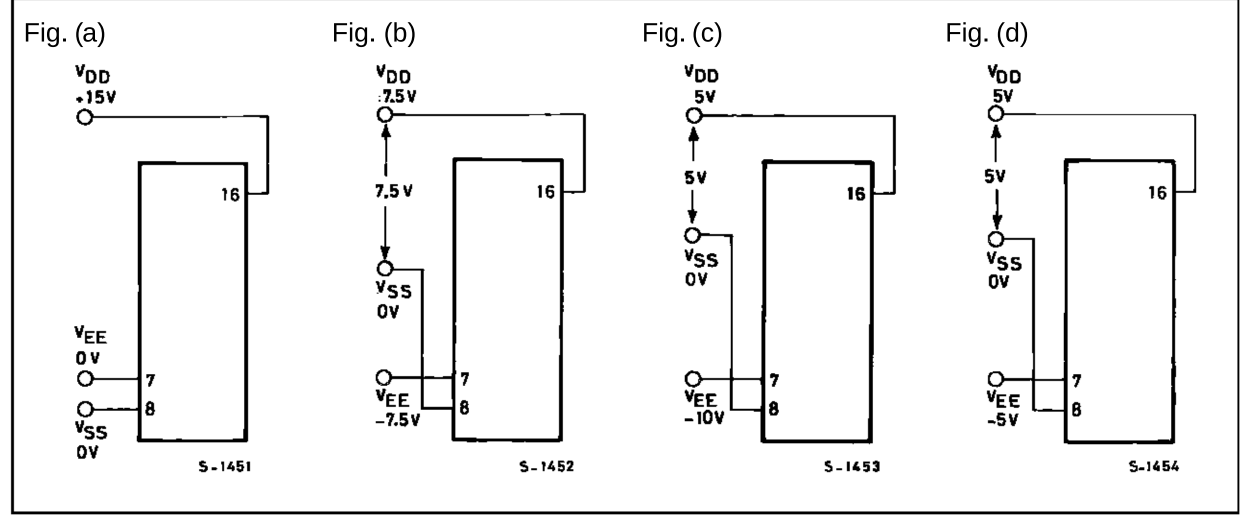
Channel Being Turned ON (R_L = 10KΩ).



Channel Being Turned OFF (R_L = 300KΩ).



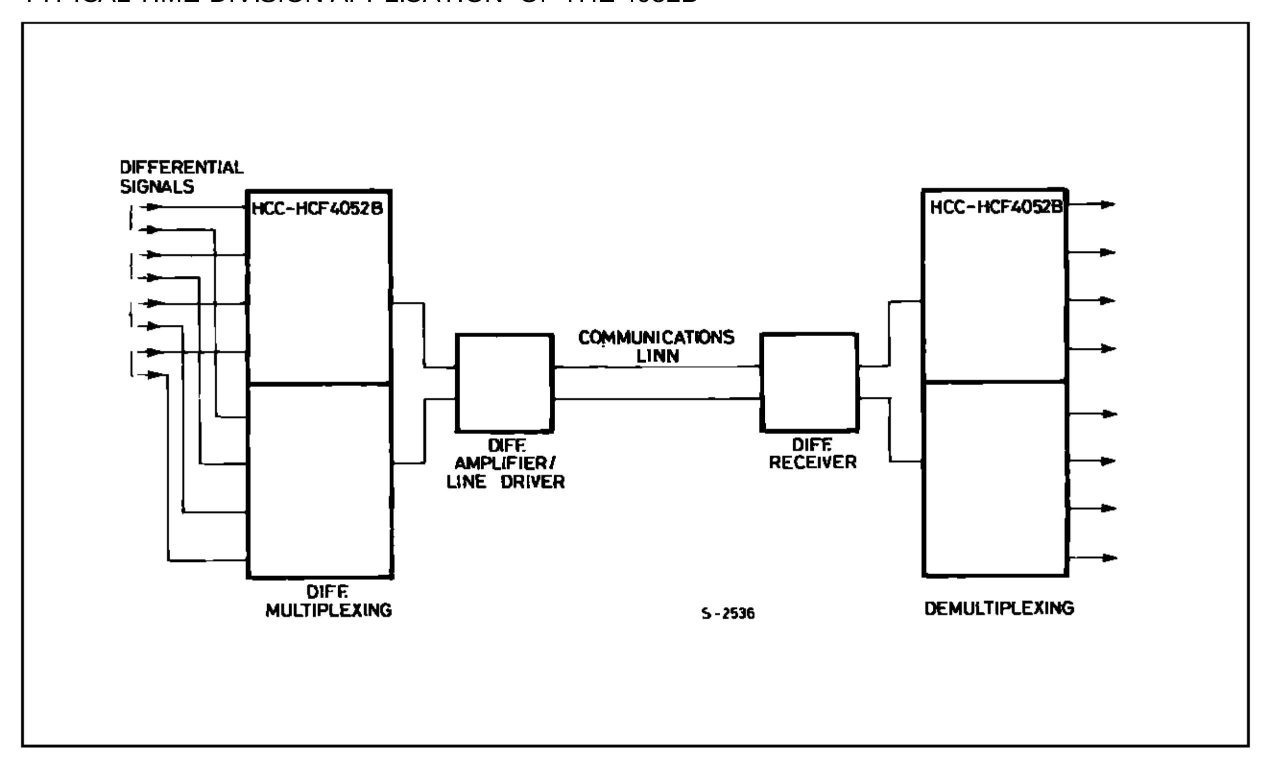
TYPICAL BIAS VOLTAGES



The ADDRESS (digital-control inputs) and INHIBIT logic levels are : ”0”=V_{SS} and ”1”=V_{DD}. The analog signal (trough the TG) may swing from V_{EE} to V_{DD}.

TYPICAL APPLICATIONS

TYPICAL TIME-DIVISION APPLICATION OF THE 4052B

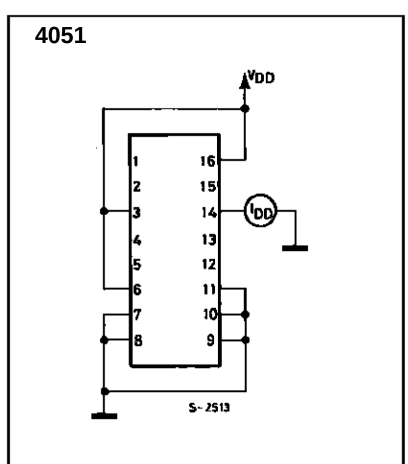


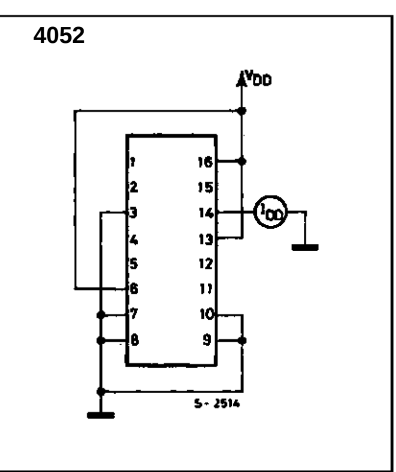
SPECIAL CONSIDERATIONS

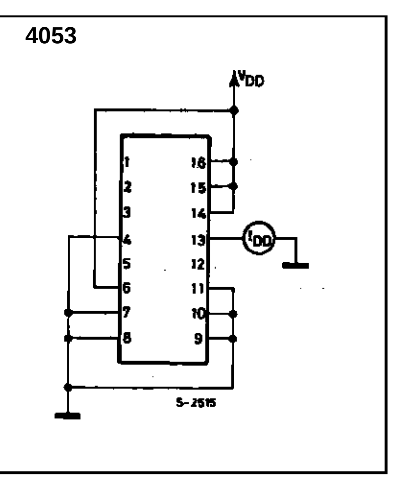
Control of analog signals up to 20V peak-to-peak can be achieved by digital signal amplitudes of 4.5 to 20V (if $V_{DD} - V_{SS} = 3V$, a $V_{DD} - V_{EE}$ of up to 13V can be controlled ; for $V_{DD} - V_{EE}$ level differences above 13V, a $V_{DD} - V_{SS}$ of at least 4.5V is required). For example, if $V_{DD} = +5V$, $V_{SS} = 0$, and $V_{EE} = -13.5V$, analog signals from – 13.5V to + 4.5V can be controlled by digital inputs of 0 to 4.5V. In certain applications, the external load-resistor current may include both V_{DD} and signal-line components. To avoid drawing V_{DD} current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0,8 volt (valvulated from R_{ON} values shown in ELECTRICAL CHARACTERISTICS CHART). No V_{DD} current will flow through R_L if the switch current flows into lead 3 on the **HCC/HCF4051** ; leads 3 and 13 on the **HCC/HCF4052** ; leads 4, 14, and 15 on the **HCC/HCF4053**.

TEST CIRCUITS

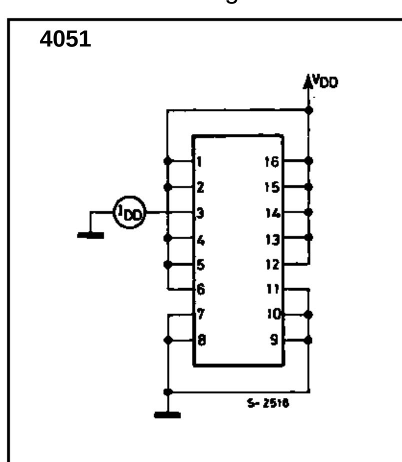
Off Channel Leakage Current-any Channel OFF.

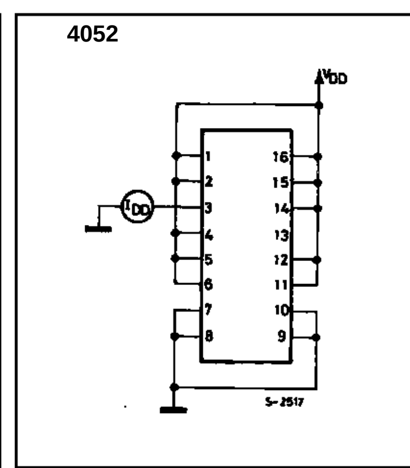


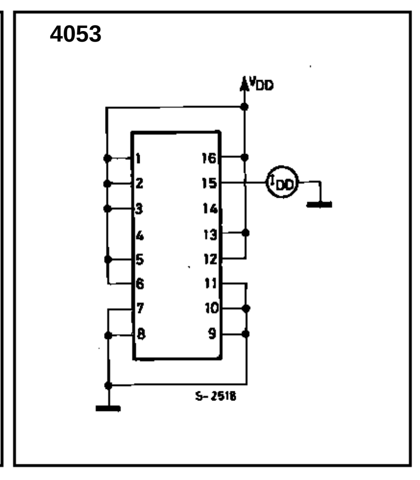




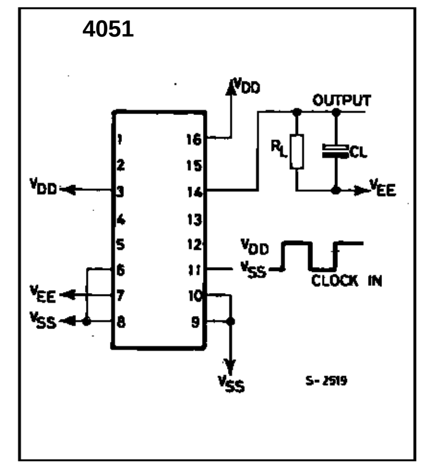
Off Channel Leakage Current-all Channel OFF.

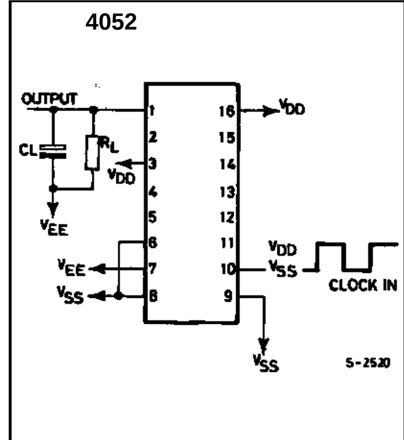


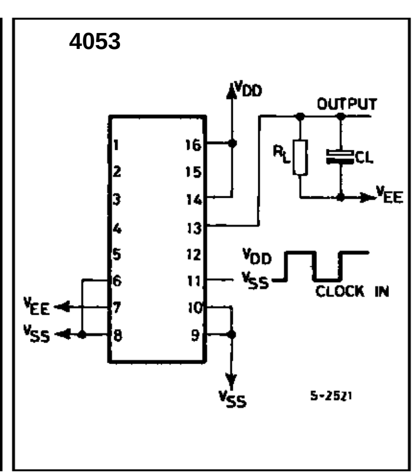




Propagation Delay-adress Input to Signal Output.

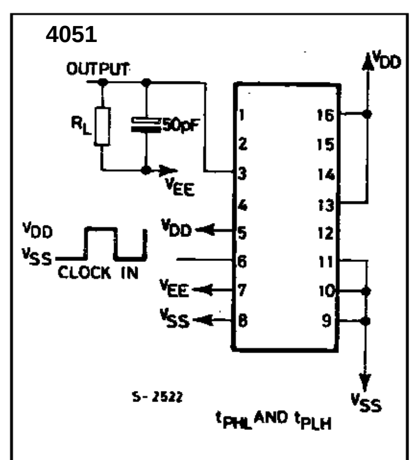


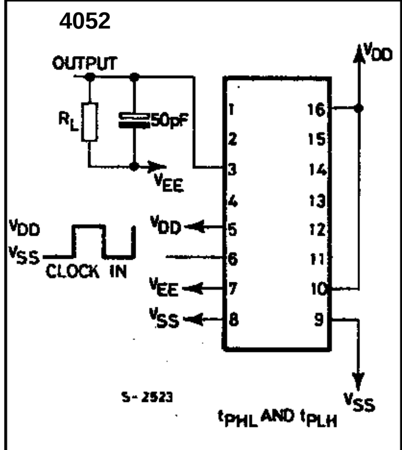


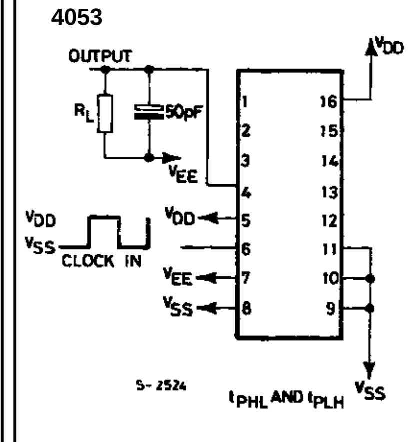


TEST CIRCUITS (continued)

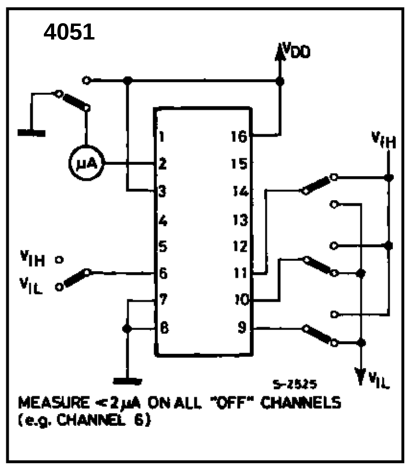
Propagation Delay-Inhibit Input to Signal Output.

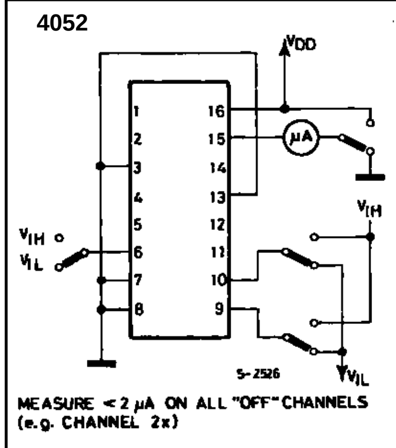


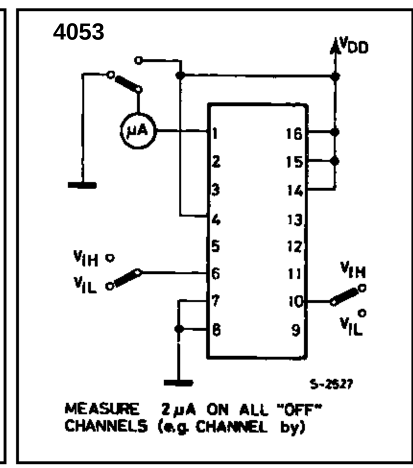




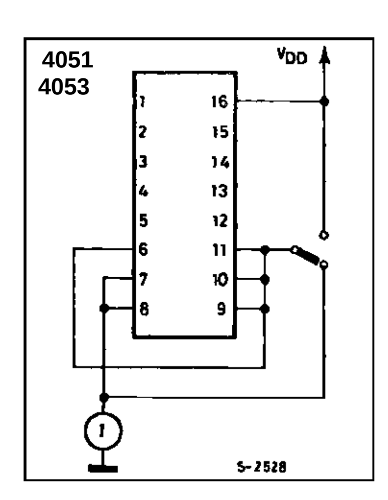
Input Voltage.

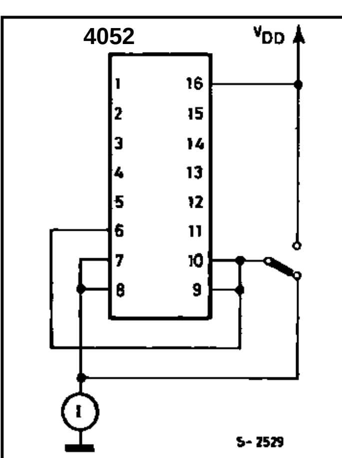




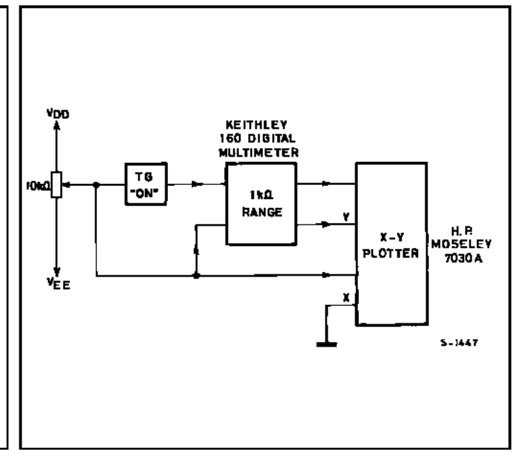


Quiescent Device Current.



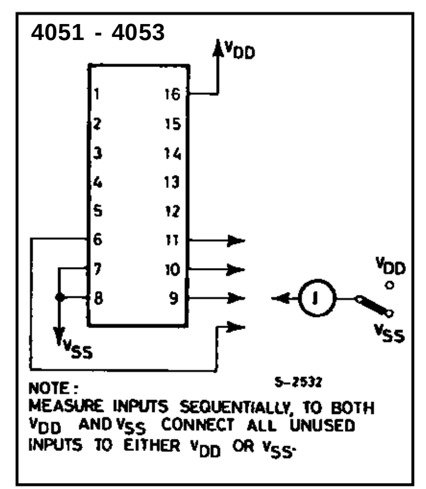


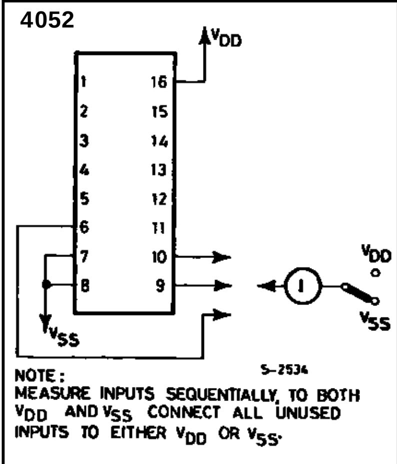
Channel ON Resistance Meaurement Circuit.



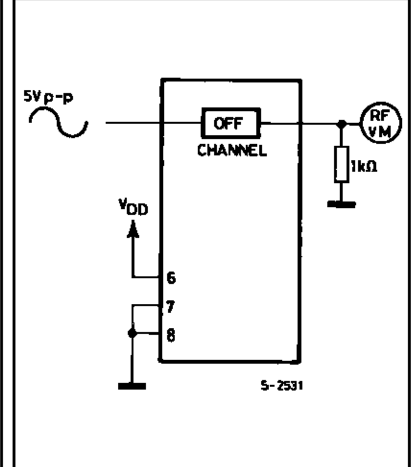
TEST CIRCUITS (continued)

Input Current.

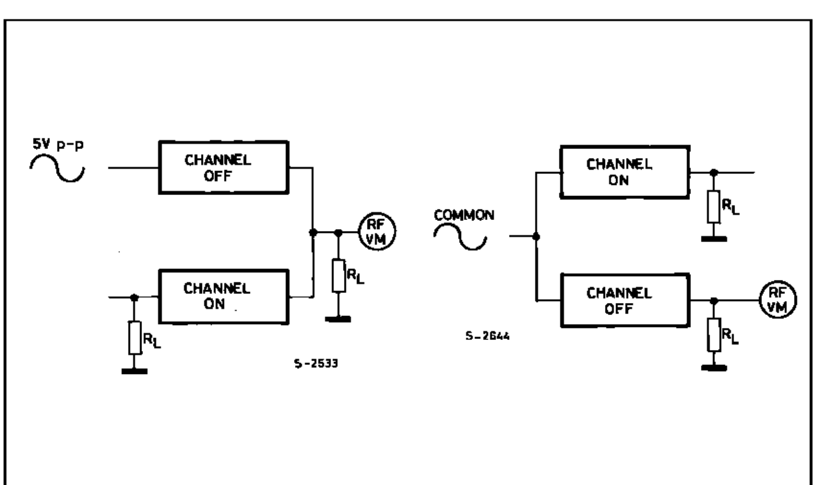




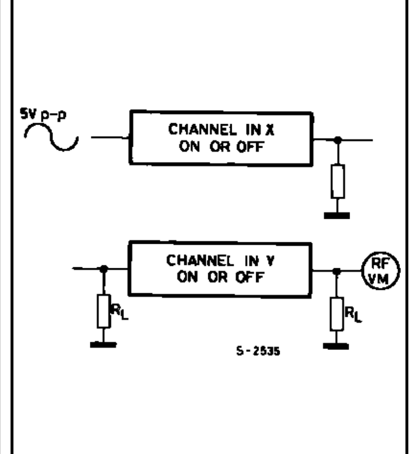
Feedthrough (All Types).



Crosstalk Betwen any two Channels (All Types).

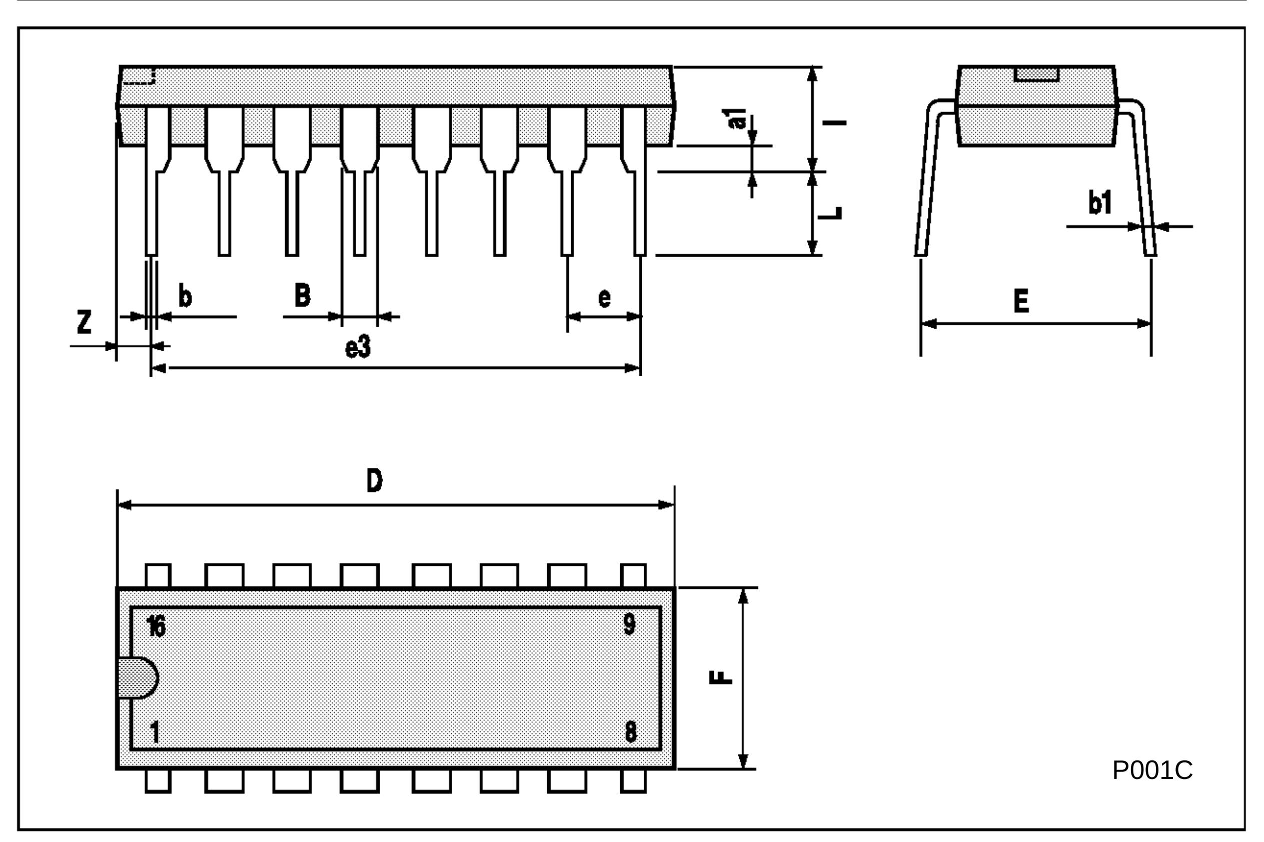


Crosstalk Betweenn Duals or Triplets (4052-4053).



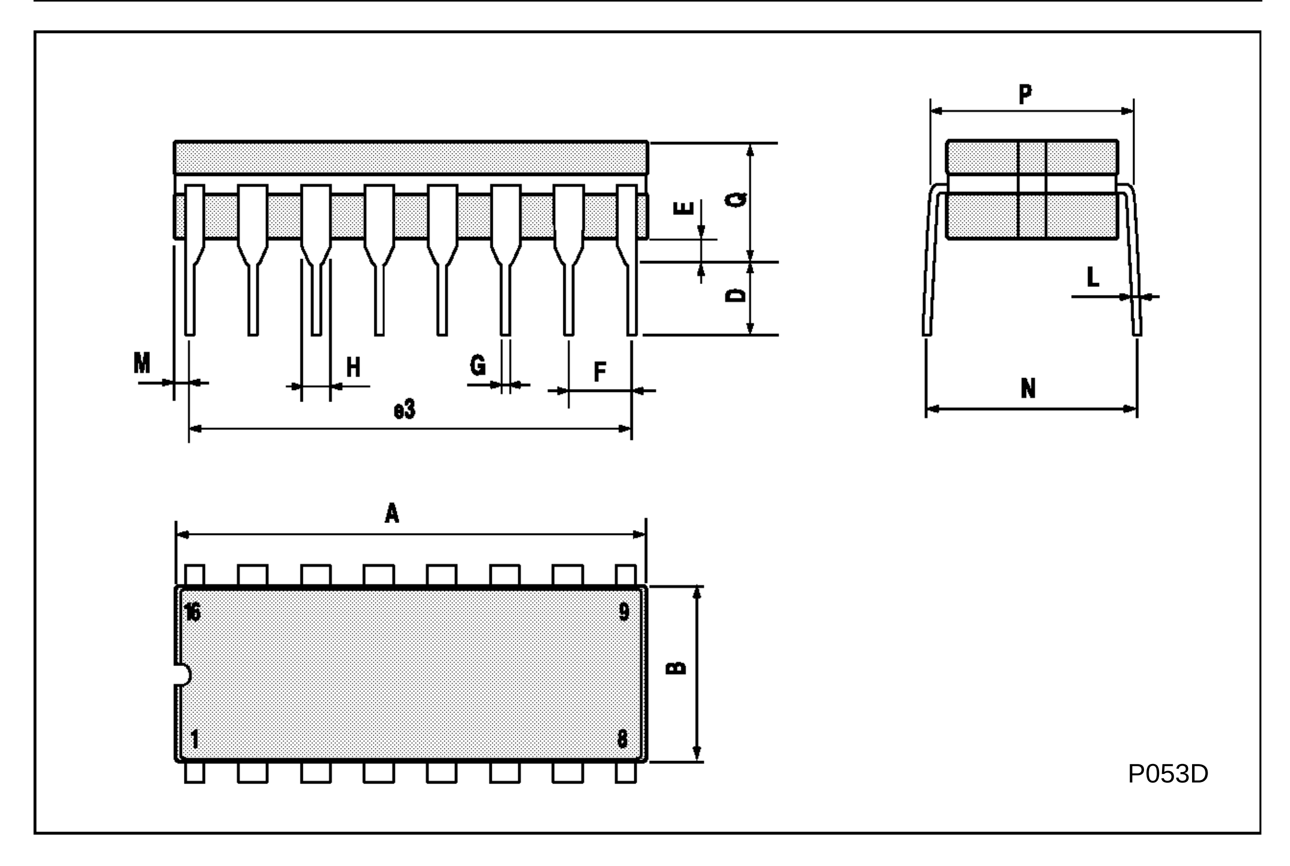
Plastic DIP16 (0.25) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



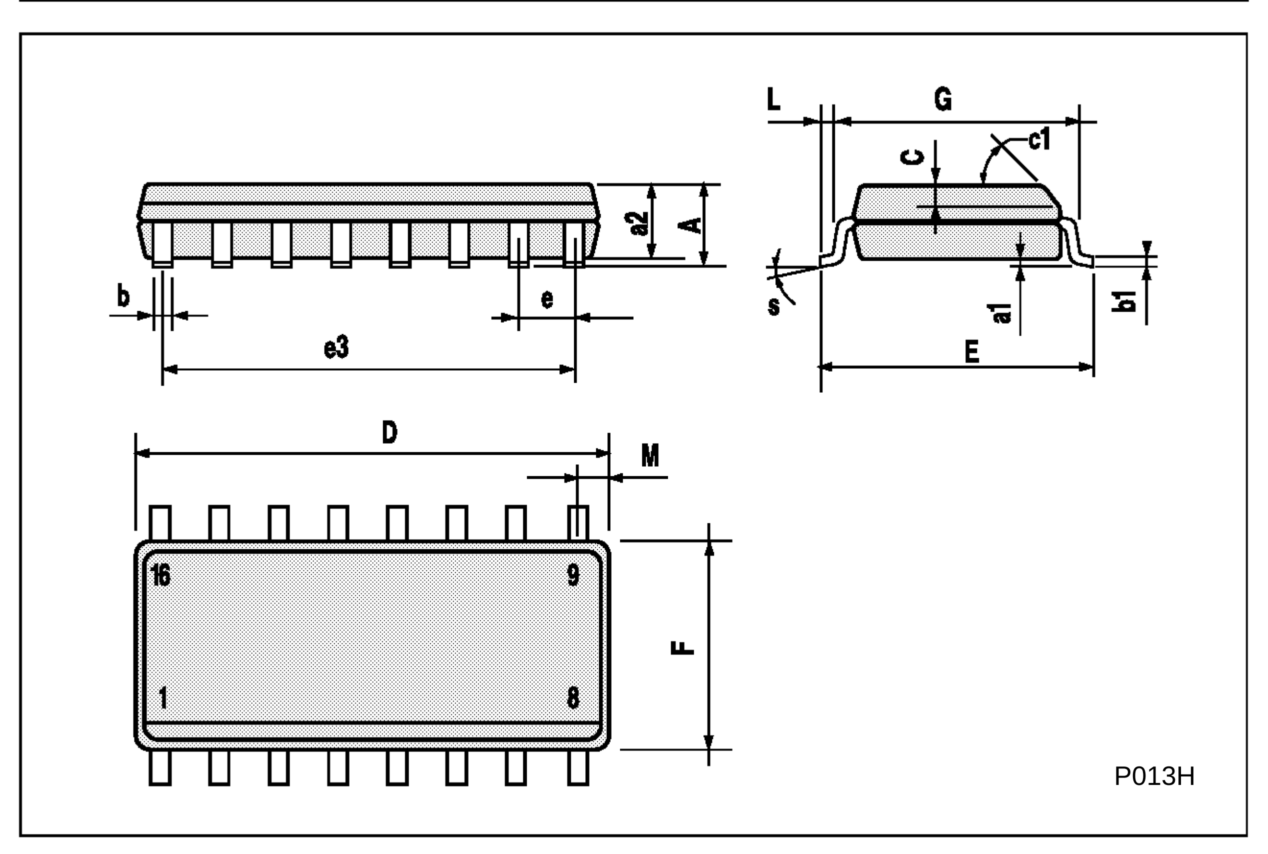
Ceramic DIP16/1 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



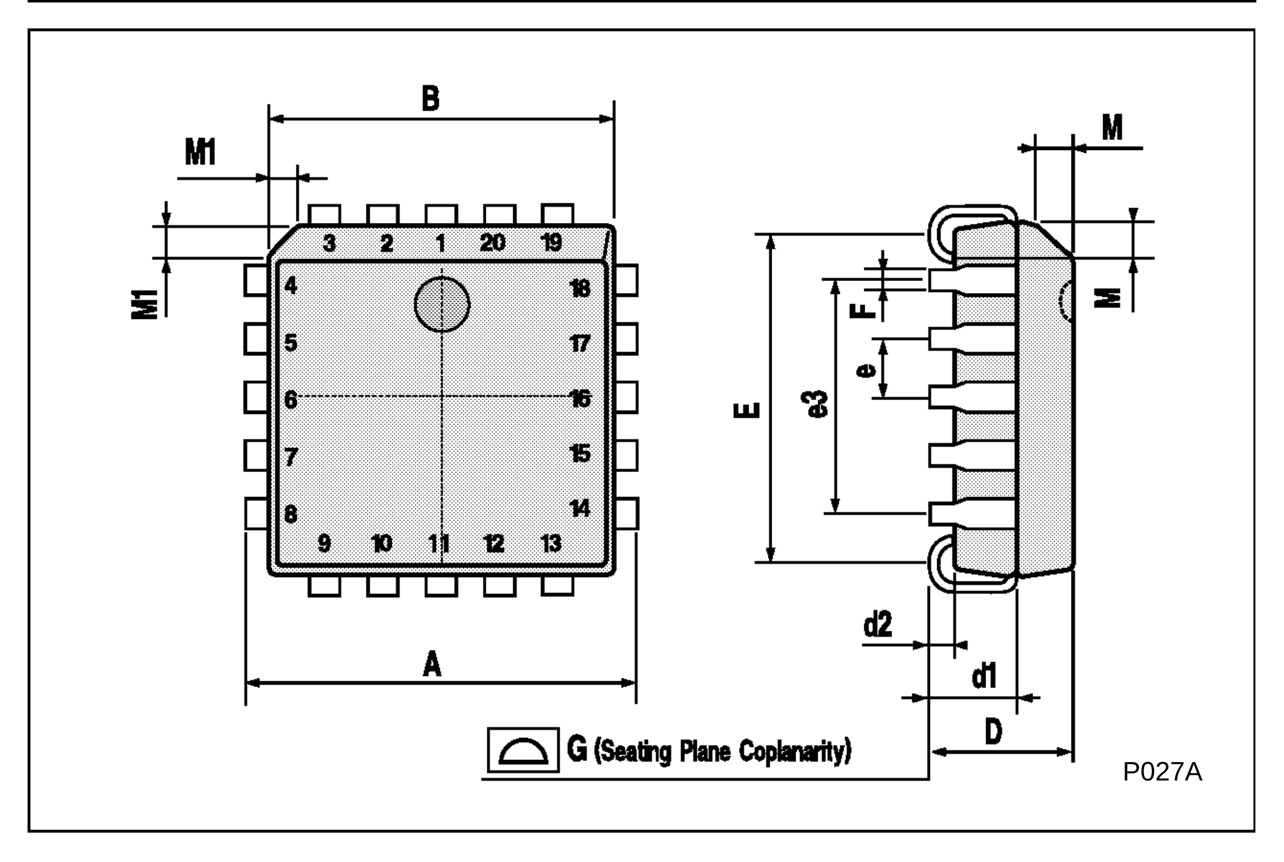
SO16 (Narrow) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



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